High Frequency Current

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Short Wave Diathermy

* Short wave diathermy is the use of high frequency electromagnetic waves of the frequency between 107 and 108Hz, and a wavelength between 30 and 3 m to generate heat in the body tissues. It provides the deepest form of heat.

* The therapeutically used frequencies and wavelengths are 27.12 MHz and 11 m (commonly).

* The less common frequencies and wavelengths are 40.68 MHz and 7.5 m and 13.56 MHz and 22 m

Principle :-

* It is not possible to produce high frequency currents by some mechanical device which produces sufficient rapid movements.

* This type of current can only be produced by discharging a condenser through an inductance of low ohmic resistance.

* If a current of very high frequency is required, the capacitance and inductance should be small and if a current of low frequency is required the capacitance and inductance should be large.

* This is the mechanism of production of high frequency current.

Production of SWD

The system consists of two circuits:-

1. The machine circuit

2. The patient circuit.

The machine circuit

* It consist of two transformers, whose primary coils are connected to source of AC.

* One is a step-down transformer and its secondary coil supplies current to the filament heating circuit of triode valve.

* The other is step-up transformer and connected to

Anode Circuit.

* Anode circuit carries the current produced by valve. Here it consists of triode valve and oscillator circuit .

* Oscillator circuit consists of condenser (XY) and inductor or oscillator coil (CD).

* Current of different frequencies are obtained by selecting suitable condensers and inductances. To produce a current of high frequency the capacitance and inductance used must be small and is made to charge and discharge repeatedly and for obtaining this an oscillator is incorporated in to machine circuit along with valve circuit.

* Another coil AB lie close to oscillator coil (CD) and has one end connected to the grid of the valve and other through grid leak (GL) resistance to the filament.

The patient circuit

The patient or resonator circuit is coupled to machine circuit by a inductor coil (EF) lying close to oscillator coil (CD) and also consist variable condenser (HK) which is usually in parallel to patient terminal.

* A high frequency current is produced in the resonator circuit by electromagnetic induction. For this to happen the oscillator and resonator circuits must be in resonance with each other,

which requires that the product of inductance and capacitance must be the same for both circuits.

Working:- * The AC from main passes through primary coils of the transformers and EMF is induced in secondary coils of step-down transformer and produces current through filament of the valve. The filament is heated and thermionic emission takes place and current flows through valve.

* The EMF is induced in the secondary coil of step-up transformer and provided that anode of valve is positive and filament is negative, current flows in anode circuit.

The electrons flows from filament to anode through valve, through oscillator coil in direction C to D and to transformer back to filament.

* The electron form in CD will induce EMF in coil AB in direction that electrons will move to grid of valve making it negative thus blocking the flow of electrons from filament.

* This will lead to dying of current in anode circuit. This reduction in current will lead to self-induced EMF. According to Lenz law, this EMF will try to prevent fall in current by offering resistance to flow of current.

This will charge condenser X (positive) and Y (negative)

* Now when self-induced EMF totally dies away, condensers again discharges through oscillator coil, but in opposite direction (D to C).

* Flow of current from D to C induce an EMF in AB such that electrons move from A to B and grid loses its negative charge and anode current flows again.

* This sequence continues and each time condenser charges and discharges through oscillator circuit leading to production of high frequency current (SWD).

Methods of Applications

Two methods of applications are used:

1. Condenser/capacitor field method

2. Cable method.

1. Capacitor field method

The electrodes are placed on each side of the part being treated. The electrodes are sepa-rated by the skin by means of an insulating material.

To obtain desirable therapeutic effects the selection and placement of electrodes should be proper. The selection or placement of electrodes should be based on:

1. Type of electrodes
2. Size of electrodes
3. Spacing of electrodes
4. Positioning of electrodes.

1. **Type of Electrodes**

There are various types of electrodes. Electrodes could be pad electrodes, plate electrodes and disk electrodes. Each electrode consists of a metal plate surrounded by some form of insulating material.

* One type of electrode consists of a thin malleable metal plate covered with a rubber pad. This has an advantage to get moulded according to the body part.

* Another type of electrode consists of a thick rigid metal plate coated with a thin layer of insulating material made up of rubber or plastic.

* The third type of electrode is a disk type electrode. These are having a transparent plastic cover within which a metal plate is present. These electrodes are commonly circular in shape.

Size of Electrodes

The electrodes should be larger than the diameter of the limbs and for trunk and back electrodes should be as large as possible.

Spacing of Electrodes

If the distance between two electrodes is less than the width of two pads, then the lines of force will travel through pads only and do not produce heat in the body tissues

Positioning of the Electrodes

Common positioning of electrodes used are:

1. Coplanar positioning of electrodes
2. Contraplanar positioning of electrodes
3. Monopolar method
4. Crossfire technique.

*** Coplanar positioning of electrodes**: This method is used over larger area of the body, e.g. spine and is also called parallel method of placement

*** Contraplanar positioning of electrodes**: The electrodes are placed over the opposite aspects of the limb or joint, i.e. medial and lateral aspect or anterior or posterior aspect.

*** Monopolar method**: Only one electrode is placed over the treatment area and other electrode is placed at a distance site or is not used at all.

*** Crossfire technique**: In this technique, half of the treatment is given with the placement of electrodes in one direction, i.e. medial or lateral aspect and another half is used with the placement of electrodes in other direction, i.e. anterior or posterior aspect.

2. Cable method or inductothermy

In this method, a thick insulated cable is used for treatment purposes. Electric field or magnetic field or both are achieved by the use of cable method.

Physiological Effects of SWD

* Effects on metabolism of the body

As the Van't Hoff's statement states that 'any chemical change which is capable of being accelerated is accelerated by the rise in temperature'. Therefore, all the chemical changes of the body that can be accelerated are accelerated by heat. The metabolism of the body itself is accelerated. Both the anabolism as well as catabolism is enhanced. The oxygen supply to the tissues is increased, removal of waste products is enhanced, the nutritional supply to the tissues is increased and thus the healing of damaged tissues is accelerated.

*** Effects due to increased Blood Supply**

The heat has a direct effect on the blood vessels. It causes vasodilatation of the vessels in the area of heating. Stimulation of the superficial nerve endings can also cause reflex dilatation of the arterioles. As a result of vasodilatation there is an increased flow of blood through the area, so that the necessary oxygen and nutritive materials are supplied and the waste products are removed.

*** Effects of heat on the nervous tissues**

Heat alters conduction in the nervous tissues. It produces a sense of sedation. Perception of pain is also reduced as it enhances the pain threshold.

A high frequency current does not stimulate motor or sensory nerves.

*** Effects of heat on the muscular Tissue**

Increased blood supply provides optimal environment for the muscles to contract. It provides fresh nutrients, oxygen and removes the waste products faster. Thus, efficacy of muscles to contract is increased. Rise in temperature also induces muscle relaxation due to faster removal of the waste products.

*** Effects of heat on the sweat glands**

The heat has an effect on the sweat glands as well. As

the heated blood is circulated throughout the body, it stimulates the centers for the regulation of the sweat. The production of sweat is increased and thus there is increased elimination of waste products.

Indications:-

*** Effects on Inflammation**:- The dilatation of arterioles and capillaries results in an increased flow of blood to the area which increases supply of oxygen and nutritive material. This increased flow of blood enhances the supply of more antibodies and white blood cells. The dilatation of capillaries increases the exudation of fluid into the tissues and this is followed by increased absorption which along with the

increased flow of blood through the area assists in the removal of waste products. These effects help to bring about the resolution of inflammation.

*** Effects in bacterial infections**

Inflammation is the normal response of the tissues to the presence of bacteria, the principal features being vasodilatation, exudation of fluid into the tissues and an increase in the concentration of white blood cells and antibodies in the area and thus help to destroy the bacteria.Bacteria can be destroyed by heat, but it would be impossible to raise the body tissues to the necessary temperature without causing damage to the tissues themselves.

*** Relief of Pain**

Mild degree of heating is found to be effective in relieving pain, presumably as a result of a sedative effect

*** Effects on muscle tissue**

The heating of the tissues induces muscle relaxation, so short-wave diathermy may be used for the relief of muscle spasm associated with inflammation and trauma.

*** Traumatic conditions**

The beneficial effects of short wave diathermy on traumatic lesions are similar to those produced in

inflammation

*** Reducing healing time**

To promote the healing of a wound or injured tissue, an increased blood supply to the tissues may be of beneficial.

Dangers of Short Wave Diathermy

1. Burns
2. Electric shock
3. Overdose
4. Faintness
5. Dangers to hearing aids or cardiac pacemakers

6.Dangers to other equipments

Contraindications of Short Wave Diathermy

1. Open wound or hemorrhage
2. Metal in the tissue
3. Disturbed skin sensation
4. Venous thrombosis or thrombophlebitis
5. Arterial disease
6. Menstruation
7. Pregnancy
8. Tumors

9. Deep X-ray or cobalt therapy
10. Children
11. Mentally retarded patient
12. Unconscious patient
13. Epileptic patients
14. Uncooperative patient

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